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Batiste et al.

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(54) **METHOD AND APPARATUS FOR TREATING A STEEL ARTICLE**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,880,477 A 11/1989 Hayes et al.
5,458,704 A 10/1995 Bobbert et al.

(Continued)

FOREIGN PATENT DOCUMENTS

AU 564998 9/1987
JP 11012678 1/1999

OTHER PUBLICATIONS

International Search Report for PCT/US 13/46506, Mailed Nov. 1, 2013.

(Continued)

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(57) **ABSTRACT**

A method for forming and treating a steel article of a high strength and ductile alloy. The method includes the steps of providing a starting steel composition for the steel article, preheating the composition, heating the starting material to a peak temperature range in less than forty seconds, holding the heated steel composition at the peak temperature range for between two and sixty seconds, quenching the heated steel composition from the peak temperature range to below 177° C. (350° F.) at a temperature rate reduction of 200 to 3000 ° C./sec (360 and 5400° F./sec), removing residual quench media from the surface of the quenched steel composition, tempering the quenched steel composition at a temperature of 100 to 704° C. (212 to 1300° F.); and air cooling the tempered steel composition to less than 100° C. (212° F.) to form a steel having desired mechanical properties.

37 Claims, 9 Drawing Sheets